THE EFFECTS OF AN INTERIM MINIMUM FLOW FROM THE CONOWINGO DAM ON FISH FEEDING AND BENTHOS IN THE SUSQUEHANNA RIVER

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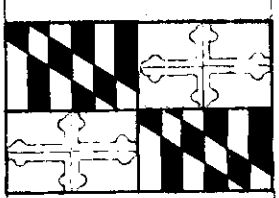

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FOREWORD AND ACKNOWLEDGEMENTS

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ABSTRACT

A 5,000 cfs minimum flow was instituted in the Susquehanna River below Conowingo Dam from 15 April to 15 September in 1982 and 1983. Studies to examine the effects of this flow on the feeding of fish and on the abundance of the benthic invertebrate community were conducted.

Benthic invertebrates were collected in both years with artificial substrates (basket samplers) and a T-sampler. Samples were collected approximately monthly from July to December in two habitats: channel (always submerged) and exposed (dewatered at flows less than 5,000 cfs). The effect of the minimum flow on benthic invertebrates was studied by comparing invertebrate abundance in channel and exposed habitats before and after 15 September; and by comparing basket sampler data collected in 1982 with similar data collected in 1980, before institution of the minimum flow. Overall, benthic abundance increased during the periods of sustained minimum flow, but the response was species-specific. Several benthic invertebrates, most notably Cheumatopsyche (caddis fly) and chironomid larvae, were several orders of magnitude more abundant when the minimum flow was maintained. Other organisms, such as the amphipod Gammarus fasciatus, did not appear to be affected by flow variation. Typically, the organisms least affected by flows of less than 5,000 cfs were more mobile than the others and apparently could quickly recolonize habitats dewatered at low flow.

Three fish species (white perch, yellow perch, and channel catfish) were collected by use of boat-mounted electroshocking equipment every 3 hours on 13 days in 1982 and 1983. Cheumatopsyche larvae constituted at least one-third of the diet biomass for each of the fish species, and was the only prey important in the diet of all three fish species. Chironomid larvae and Gammarus fasciatus constituted more than 30% of the diets of channel catfish and yellow perch, respectively. Flow conditions at the time of capture had little effect on the feeding intensity of the fish, but did affect diet composition.

To examine the effect of the sustained minimum flow on fish feeding, stomach content data collected in 1982 and 1983 were compared with similar data collected in 1980, before institution of the minimum flow. This comparison indicated that fish consumed several times more prey in the years when the 5,000 cfs flow was maintained. The prey taxa that were most enhanced by the minimum flow, Cheumatopsyche and chironomid larvae, were an order of magnitude more abundant in the stomachs

of fish collected after institution of the minimum flow. Fish condition (weight at length) was also examined and found to be significantly greater in 1983 than in 1980. These results suggest that institution of a 5,000-cfs minimum flow at Conowingo Dam has increased the abundance of benthic invertebrates, and thus has enhanced the feeding and condition of the resident fishes in the lower Susquehanna River.

KEYWORDS: Hydroelectric
Fish feeding
Benthos
Drift
Minimum flow
Susquehanna River

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I. INTRODUCTION

A. BACKGROUND

The hydroelectric facility at Conowingo Dam is located about 10 miles upstream from the mouth of the Susquehanna River. The plant is primarily a peaking unit: it generates near capacity at times of high demand (typically, during the day on weekdays) and shuts down during off-peak hours (nights and weekends). This schedule produces fluctuations in water depth and velocity in the river downstream. For many years, State and Federal agencies have expressed concern about the lack of a sustained minimum flow during shutdown periods and about the effects of fluctuations in flow on the riverine biota.

The Federal Energy Regulatory Commission (FERC), recognizing these concerns, stipulated in the operating license for the Conowingo facility that the licensee, Philadelphia Electric Company (PECO), conduct studies to "determine minimum flow releases which are necessary to protect and enhance fish and wildlife resources" (Objective 5, Article 34). In response to this stipulation, PECO, the Susquehanna River Basin Commission (SRBC), and the Power Plant Siting Program (PPSP) of the Maryland Department of Natural Resources have all sponsored research programs. The utility-sponsored studies have centered on attempts to estimate population sizes and describe movement patterns of the resident fish species. Other groups have studied the following:

- The effects of dewatering on the survival of white perch eggs (Shenker and Hepner 1980)
- The abundance and the stomach contents of resident fishes (Foerster 1976, Pavol and Davis 1982, Environmental Resources Management 1981a)
- The responses of benthic invertebrate populations on artificial substrates to flow fluctuations caused by dam operations (Janicki and Ross 1982)
- The instream flow needs for resident fishes of the lower Susquehanna River (Jackson and Lazorchick 1978).

In 1982, FERC ordered that an interim minimum flow of 5,000 cubic feet per second (cfs) be maintained from 15 June through 15 September. Establishment of a permanent minimum flow must await determination of whether this interim minimum

flow or other minimum flows will enhance fish populations below Conowingo Dam. As discussed below, the previously collected data cannot satisfactorily answer questions concerning effects of the interim minimum flow; thus, this study was undertaken in an attempt to provide the needed information. It is designed to build on existing data within the physical constraints of studying the fish populations in a river as large as the Susquehanna below Conowingo Dam. The study takes the approach of determining how the 5,000 cfs flow affects population size of fish prey and by examining the effects of flow on the trophic dynamics of fish.

B. APPROACH AND RATIONALE

The most direct method for determining the effect of minimum flows on fish populations is to measure the size of these populations before and after instituting a minimum flow. However, measuring fish population size is difficult, particularly in a river system as large as that below Conowingo Dam. Data from catch-per-unit-effort (CPUE) studies characteristically have high variances; and data from collections made with gill nets, electroshocking, and a fish lift below Conowingo Dam show the same pattern (ERM 1981; RMC, unpublished data). Richkus (1983) has estimated that, for most fish species, current CPUE collections in the Susquehanna River cannot detect even order-of-magnitude changes in population size between years. Further, population estimates obtained by mark-recapture techniques below Conowingo Dam before establishment of a minimum-flow population had 95% confidence limits that were many times larger than the estimate itself (Environmental Resources Management 1981a). Thus, because of the large variance associated with current population estimates, as well as pre-1982 estimates, direct comparison of population size before and after institution of the present minimum flow is not a satisfactory means of determining the effect of that flow or of projecting the effects of alternative minimum flows.

An alternate method for determining the effect of minimum flows on fish populations is to measure the effect of the minimum flow on their principal food source, benthic invertebrates, and to relate those changes to their potential effect on fish poulation size. This trophic dynamic approach is used in our report because benthic invertebrates are sedentary, and their population sizes are more easily measured than fish. Numerous laboratory and field studies have shown flow to be a principal factor affecting the size of aquatic insect populations (e.g., Hynes 1970, Trotzky and Gregory 1974, Hauer and Stanford 1982, Hooper and Ottey 1982, Gislason 1985), and benthic invertebrates form the principal food source for many of the fish

species below Conowingo Dam. Population size of prey can affect feeding habits of fish, as well as fish growth rate and condition, all of which are measurable. In turn, individual growth rates of fish can affect population growth rate and population size. While less direct than measuring fish population size, measurement of benthic invertebrate populations and fish feeding behavior provides a more obtainable measure of the effects of a minimum flow from Conowingo on the downstream biota.

C. OBJECTIVES

The overall objective of the studies conducted at Conowingo Dam was to determine how the imposition of a 5,000-cfs minimum flow has affected the fish resources of the lower Susquehanna River. The specific objectives were to accomplish the following:

- Identify the important prey of three abundant resident fishes (white perch, channel catfish, and yellow perch) (Chapter III)
- Determine the effects of dam operations on the abundance and composition of the benthic invertebrate community below Conowingo Dam (Chapter II)
- Examine the effects of dam operations on invertebrate drift below Conowingo Dam (Chapter VI)
- Define short-term changes in the feeding behavior of the resident fishes in response to changes in dam operations (Chapter IV)
- Compare prey consumption and length-weight relationships for these fish species before and after the institution of the 5,000-cfs minimum flow (Chapter V).